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CONTRIBUTIONS FROM THE BERMUDA BIOLOGICAL STATION FOR RESEARCH. No. 135.

THE PARASITIC WORMS OF THE ANIMALS OF BERMUDA.

I. TREMATODES.

By Franklin D. Barker.

With Three Plates.

(Continued from page 3 of cover.)

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I. TREMATODES.

FRANKLIN D. BARKER.

Received Feb. 12, 1922. Presented by E. L. Mark, March 8, 1922.

INTRODUCTION.

THROUGH the courtesy and generous assistance of Professor E. L. Mark, Director of the Bermuda Biological Station, and of the National Academy of Science, it has been my privilege to spend two seasons at the Bermuda Station, collecting and studying the parasitic fauna. The following paper is the first of a series which will embody the results of these investigations.

The two forms here described were found in the stomach of a Hawk's-bill Turtle, *Chelonia imbricata* (Linn.), at the Bermuda Biological Station.

Pachypsolus brachus, n. sp.

(Pls. I and II, Figs. 1–8, 12).

1. MORPHOLOGY.

General Appearance.— The description of the following species is based on the study of 27 preserved specimens, 11 of which were killed and fixed in 2% formol and 16 in vom Rath's osmio-sublimate mixture. Little difference can be seen as a result of the different killing reagents other than in color. Specimens fixed in formol are grayish-yellow, those fixed in vom Rath's fluid black. A detailed study has been made of specimens in toto, both unmounted and mounted, and of series of frontal and sagittal sections.

The body is oval and plump (Pl. II, Fig. 8), being one half as thick as wide. The length varies from 3 mm. to 3.7 mm., the mode being 3 mm., which is the length of 50 per cent of the individuals. The width varies from 1.5 to 1.9 mm., the mode being 1.7 mm., which is the width attained by 60 per cent. The ends are bluntly rounded,

the anterior end slightly more tapering than the posterior. In the median line at the posterior end is a well defined terminal invagination, which marks the position of the excretory pore. The dorsal surface of the body is strongly arched, the ventral surface slightly cupped. The sides are nearly parallel with the exception of a wide, shallow constriction midway between the ends at the level of the acetabulum. Spines or scales were not found anywhere on the body.

In the preserved specimens, the anterior third of the body shows a marked and constant tendency to flex ventrad, which gives rise to a well defined and rather deep ventral cup between the oral and ventral suckers. This cup-like depression persists in compressed specimens and possibly functions as a secondary holdfast (Pl. II, Fig. 8).

The oral sucker is comparatively large, well defined, nearly circular in outline and ventral in position, with its dorso-ventral axis at right angles to the chief axis of the body. In compressed specimens the oral sucker is 0.80 mm. to 0.82 mm. wide by 0.66 mm. to 0.82 mm. long. In frontal sections it measures 0.82 mm. wide by 0.82 mm. long. The ventral sucker, or acetabulum, lies in the median area at the posterior margin of the anterior half of the body and faces obliquely cephalad. It is of approximately the same size and shape as the oral sucker. It measures 0.60 mm. to 0.74 mm. in length by 0.70 mm. to 0.74 mm. in width in compressed specimens and 0.72 mm. by 0.80 mm. in frontal sections.

The genital pore is not salient and lies in the median line, at the anterior margin of the acetabulum, or else slightly to the left of, and just anterior to the acetabulum.

In the middle quarters of the body (Pl. I, Fig. 2), along the sides, and extending well toward the median line on the dorsal surface, can be seen the characteristic dark colored, convoluted tubular and finely granular vitelline glands in moss-like patches. The uterus appears as a dark coiled mass nearly filling the ventral field of the posterior third of the body.

Digestive System.— The transversely oval mouth leads into the triangular lumen of the oral sucker, which is 0.90 mm. deep in sagittal sections with thick muscular walls. A thick walled, large and powerful cup-shape pharynx follows immediately (Pl. II, Fig. 12). The pharynx measures 0.58 mm. long by 0.52 mm. wide by 0.44 mm. deep in sagittal sections. Eight longitudinal muscular ridges or folds project from the inner wall of the anterior two thirds of the pharynx into its lumen. Of the four larger or primary ridges, one is dorsal, one ventral, and two lateral; alternating with these are four smaller

or secondary ridges. An œsophagus is not present, the common transverse caecum following immediately behind the pharynx. On each side of the pharynx a single well defined diverticulum extends cephalad from the transverse caecum lateral, or dorso-lateral, to the oral sucker to a height of one half the sucker's depth. These diverticula may or may not bifurcate at their terminations. The lateral caeca are broad and deep and they extend in an undulating course to the posterior end of the body, where they end blindly, giving off in their course numerous small lateral and deep ventral diverticula. The caeca are deeper than wide and lie in a plane mid-way between the dorsal and ventral surfaces in the lateral fields of the body (Pl. II, Fig. 12).

Male genitals.— The two testes (Pl. I, Figs. 1, 5), of medium and nearly equal size, irregular in shape and with undulating to slightly lobed margins, are situated in the same transverse plane midway between the anterior and posterior ends of the body. The testes vary in size from 0.58 mm. to 0.68 mm. by 0.34 mm. to 0.54 mm. The right one is slightly behind the posterior margin of the acetabulum and its left end projects beyond the median plane into the left half of the body. The bulk of the left testis is farther from the median plane than is the left margin of the acetabulum, and its anterior end extends a little farther forward than the posterior margin of the acetabulum. From the antero-dorsal margin of each testis a small vas efferens passes obliquely forward and toward the median plane. These unite just cephalad and dorsad to the ovary to constitute the vas deferens (Pl. I, Fig. 3); this continues in the median area to the base of the cirrus pouch, which it enters. The cirrus pouch, though comparatively short, is an elongated pear shaped organ situated immediately anterior to the acetabulum, with its long axis nearly perpendicular to the frontal plane of the body. It is 0.96 mm. long and from 0.24 mm. to 0.28 mm. in diameter, being a little longer than the acetabulum is deep, so that its base lies slightly dorsad and cephalad to the acetabulum. It is so short that it does not bend around the acetabulum. The vas deferens upon entering the base of the cirrus pouch unites with the enlarged transversely coiled seminal vesicle, which fills the basal third of the pouch. The seminal vesicle connects, in turn, with a comparatively wide prostatic duct, which has an undulating course and tapers toward the distal end of the pouch, where it merges into the ejaculatory duct of the short cirrus.

The cells forming the prostate gland (Pl. I, Fig. 3) occupy the peripheral portion of the pouch and extend from the seminal vesicle

nearly to the distal end of the pouch. Fine ducts leading from the prostate cells occupy the medullary portion of the pouch and enter the prostatic duct. The lumen of the cirrus is lined with cuticula, while the lumen of the prostatic duct is covered with high filamentous papillae.

The wall of the cirrus pouch possesses a heavy outer sheet of longitudinal muscle fibers and a thin inner one of circular fibers. The cirrus, which is approximately one-fifth the length of the cirrus pouch, has an outer and an inner muscular component. The outer component comprises an outer sheet of longitudinal muscle fibers and a heavier inner sheet of circular fibers. The inner muscular component immediately surrounds the lumen of the cirrus and the prostatic duct and is likewise composed of an inner sheet of circular muscle fibers and an outer sheet of longitudinal fibers. The cirrus pouch is anchored and possibly controlled by a pair of oblique muscles which are attached respectively to the cephalic and caudal faces of its base.

The cirrus opens into a common genital atrium, which has its outlet in the genital pore lying in, or a little to the left of, the median line and slightly anterior to, or just under, the anterior margin of the acetabulum.

Female genitals.— The ovary (Pl. I, Figs. 1, 5, 6, Pl. II, Fig. 7) lies near the middle of the body, in the median area, dorsal to the posterior portion of the acetabulum and is from one-half to two-thirds the bulk of one of the testes, globular in general form with undulating or slightly lobed outline. In the specimen figured (Fig. 5) it measured 0.38 mm. by 0.38 mm.

The oviduct leaves the ovary from the middle of its anterior margin and at once turns sharply mediad; after making several loops it passes caudad in descending transverse coils, lying a little to the right of the median plane, to the end of the body, where, turning, it winds cephalad, a little to the left of the median plane, in ascending transverse coils; the terminal portion passes between the testes and thence to the left and dorsally over the acetabulum; finally it turns to the right and crosses obliquely the distal third of the cirrus pouch (Pl. I, Fig. 3), where it enters a well defined metraterm or vagina. The base of the metraterm is enlarged and lies across the left side of the terminal portion of the cirrus pouch, but the neck parallels the pouch and terminates anteriorly and to the left of the pouch in the common genital atrium. The wall of the metraterm is thickened and supplied with an inner sheet of circular muscle fibers and an outer sheet of longitudinal fibers. An invagination of the cuticula appears to form the lining of its lumen, the wall of which is transversely ridged.

A diffuse, but well defined, shell-gland (Pl. I, Fig. 6), or gland of Mehlis, lies dorsal, and for the most part anterior, to the ovary. Its posterior portion covers the anterior third of the ovary. The oviduct penetrates the mass of shell-gland cells, which are connected with the oviduct by numerous minute ducts.

A globular compact receptaculum seminis (Pl. I, Figs. 1, 5, 6), one-third the bulk of the ovary, lies dorsal to the shell-gland and the anterior half of the ovary. A small duct leaves its anterior margin and turning mediad joins the oviduct soon after it leaves the ovary.

At the junction of the receptaculum duct with the oviduct a tubular Laurer's canal (Fig. 6) originates and in a slightly undulating course makes its way dorsad and opens on the dorsal surface of the body dorsal to the ovary and the posterior part of the acetabulum and slightly to the right of the median line.

The vitellarium (Pl. I, Figs. 1, 2, 5) is rather striking in appearance and is composed of two masses of convoluted tubules grouped in moss-like patches, which lie in the lateral and latero-dorsal fields in the middle three-fifths of the body. The patches are fairly definite and constant in number, three patches being present on the right and four on the left side. They extend forward of the anterior margin of the acetabulum a distance approximately half of the diameter of that organ, the posterior limit being about mid-way between the testes and the posterior end of the body. The latero-dorsal patches are dorsal to the testes and uterine coils. A fine vitelline duct (Pl. I, Fig. 6) connects with each other the patches or groups of each side and a larger vitelline duct leaves the central group of each side and passes transversely mediad to unite with the one from the opposite side to form a small, but distinct, vitelline reservoir, which lies dorsal to the left margin of the ovary. From the reservoir a small duct leads cephalad and joins the oviduct a short distance beyond the union of the receptaculum duct with the oviduct.

The eggs (Pl. I, Fig. 4) are numerous, spindle shaped, light brown in color, with thick shell. A comparatively large, well-defined and easily separated operculum is present, and a slight opercular rim can be detected. The opercular pole is the more pointed. The eggs measure 0.0375 mm. to 0.0450 mm. in length by 0.015 mm. to 0.020 mm. in width. The older eggs contain a well developed embryo, but many appear empty, which probably indicates a non-fertile condition.

Excretory System.— The excretory system (Pl. II, Fig. 7) is voluminous and consists of an enormous median dorsal reservoir, with a pair of anterior prolongations. The reservoir is one-fourth the width and

one-half the depth of the body, and extends from the posterior end of the body to the posterior margin of the ovary, where it bifurcates, one arm passing to the left and one to the right of the ovary; the arms extend cephalad around the oral sucker to the anterior end of the body. The reservoir and arms give off numerous long lateral and deep ventral diverticula, but these do not anastomose. The reservoir terminates behind in a short narrow median canal at the posterior end of the body, which ends in a well-defined excretory pore, terminal in position and nearer the ventral than the dorsal surface. The short excretory canal appears to be lined with cuticula. The entire excretory system is filled with a mass of fine globular, gray and golden, glistening particles among which are numerous larger globular bodies which stain a bright blue with methylen blue.

2. Taxonomy.

Braun (1901, p. 36) described under the name of *Distomum irroratum* R. a trematode found in the intestine of a sea turtle, *Thalassochelys caretta*, from New Guinea, which has a number of characters similar to the trematode described in this paper. Looss (1901, p. 558) described a similar trematode found in the stomach of a sea turtle, *Thalassochelys corticata*, from Triest, which he named *Pachypsolus lunatus*. In a later paper Looss (1902, p. 485), after a careful comparative study of new adult specimens, as well as the forms described by Braun and by himself, reached the conclusion that all were specimens of *Distomum irroratum* Rudolphi, those described by Braun and by himself in his earlier paper being young forms, while those studied by himself later were mature. He accordingly classified all of them as *Pachypsolus irroratus* (R.).

Looss (1902, p. 503) gives the following characters for the genus *Pachypsolus*, "Mittelgrosse Distomen mit sehr kräftigem, dickem, vorn und hinten abgerundetem, auf dem Querschnitte kurz ovalem Körper. Saugnäpfe gross und kräftig, Haut besonders im Vorderkörper mit scheinbaren Bündelen feiner stäbchenartiger Stacheln bewaffnet. Darm mit starkem Pharynx, ganz kurzem Oesophagus und Darmschenkeln, die bis auf einige von ihren Angfangstheilen nach vorn abgehende Blindsäcke einfach sind. Excretionsblase Y förmig, mit bis zum Keimstock reichendem Stamme und bis ins Kopfende sich erstreckenden Schenkeln. Stamm und Schenkel mit mässig zahlreichen, weiten und zum Theil wieder gespaltenen Seitenzweigen, die nach der Bauchseite hinabsteigen mit Ausnahme des vordersten

Paares, welches uber dem Mundsaugnapfe eine einfache Queranastomose der Schenkel bildet. Genitalporus etwas linksseitig von dem Bauchsaugnapfe, Copulationsorgane vorhanden. Cirrusbeutel cylindrisch, von beträchtlicher Länge, in seinem Innern eine mehrfach gewunden, schlanke Samenblase, lange, cylindrische Pars prostatica und dicker Penis, der sich im ausgestülpten Zustande nach seiner Spitze zu merklich verjüngt. Hoden stark seitlich hinter dem Bauchsaugnapfe. Keimstock seitlich vor ihnen; Laurer'scher Canal und Receptaculum seminis vorhanden. Dotterstöcke in den Seiten und unter der Rückenfläche, aus in der Jugend deutlich sternförmigen Follikelgruppen zusammengesetzt, Uterusschlingen hauptsächlich hinter den Hoden die ganze Breite des Körpers ausfüllend und nur die Enden der Darmschenkel freilassend. Eier zahlreich, klein, mit zugespitztem Deckelpol und dickerm Hinterende, zwischen 0,04 und 0,05 mm. lang. Bewohner des Magens von Seeschildkröten. Typus: *P. irroratus* (R.)."

The trematode from *Chelonia imbricata* which I have described has, in general, the characters of the genus *Pachypsolus*, and I do not hesitate to place it in that genus. When compared with the trematodes described by Braun and Looss under the name *irroratus* several essential differences are evident. Externally the following may be noted. The absence of spines, or scales, which may, however, have been lost, the very large and more nearly equal size of the suckers, the ventral cup-like depression and the non-salient genital pore. Internally, the position of the testes and ovary nearer the acetabulum and the less diffuse arrangement of the vitelline masses, which are more nearly like those described by Braun, may be noted. The most striking and essential difference, however, is the size and position of the cirrus pouch, which in *Pachypsolus irroratus* (Pl. II, Fig. 11) bends around the acetabulum, its posterior end extending to the level of, or posterior to, the ovary, while in the form here described (Pl. I, Fig. 3) the cirrus pouch is much shorter, parallel with the dorsoventral axis of the body and entirely anterior to the acetabulum.

Linton (1910, p. 24) has described a new species, *Pachypsolus ovalis*, found in large numbers in the intestine of a Loggerhead Turtle (*Caretta caretta*) from the Tortugas. A third species, *Pachypsolus tertius*, has been described by Pratt (1914, p. 416) from the small intestine of the same host and of the same locality. The species described by Linton and by Pratt differ from *P. irroratus* in minor points and distinctively in the position and extent of the cirrus pouch. Pratt (1914, p. 418) describes the cirrus sac in *P. tertius* (Pl. II, Fig. 9)

as "a long cylindrical structure, extending from the genital pore around the dorsal side of the acetabulum to the vicinity of the ovary and the shell-gland, and in some cases to the anterior border of the testes." According to Linton (1910, p. 25) the cirrus pouch in *P. ovalis* (Pl. II, Fig. 10) is "relatively short, reaching barely to the posterior edge of the acetabulum." Both Linton and Pratt consider the differences in the extent of the cirrus pouch, together with other minor differences, to be of specific rank. It is evident that the form which we have described resembles *P. ovalis* Linton more than it does *P. tertius* Pratt or *P. irroratus* (R.) Looss; but it differs from *P. ovalis* Linton in minor characters and distinctively in the position and lesser extent of the cirrus pouch. The difference in the length of the cirrus pouch in *P. ovalis* Linton and in the trematode here described is greater than that between *P. ovalis* and *P. tertius* Pratt and decidedly greater than that between *P. tertius* Pratt and *P. irroratus* (R.) Looss. We agree with Pratt that the "actual position is undoubtedly dependent upon the condition of contraction," but it seems improbable that this constant and marked difference could be due entirely to the contraction of the acetabulum or the body.

We feel warranted in ascribing to this difference in the position and extent of the cirrus pouch, taken together with the minor differences noted, a specific value, and therefore class this trematode as a new species in the genus *Pachypsolus*, designating it as *Pachypsolus brachus*.[1]

In the four species of *Pachypsolus* now recorded we find, in addition to differences of secondary importance, a striking gradation in the position and size of the cirrus pouch, which is the distinctive specific character. The old question, raised by Looss, arises as to specific differences and the specific effects of different hosts on the same species.

From the standpoint of geographical distribution, it is of interest to find in the Hawk's-bill Turtle from the Bermudas a different species of *Pachypsolus* from that found in the Loggerhead Turtles of New Guinea and the Mediterranean and from those found in the Loggerhead Turtles of the Tortugas.

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[1] βραχύς, short, having reference to the cirrus pouch.

Synechorchis megas, n. g. et n. sp.

(Pl. III, Figs. 13–22).

1. Morphology.

General Appearance.— Twenty-four specimens of this trematode were studied, twelve of which were fixed in 2% formol and twelve in vom Rath's osmio-sublimate mixture. In general the body is boat- or cradle-shaped, the dorsal surface being strongly convex both longitudinally and transversely and the ventral surface correspondingly strongly concave. The body tapers slightly toward the anterior end making the posterior end the broader and more bluntly rounded. In unmounted specimens the length varies from 4.2 mm. to 9 mm. and the width from 2.2 mm. to 3.2 mm. The thickness of the body is 1.04 mm. with slight variations. No cuticular spines or scales were found.

At the anterior end of the body is a well defined terminal cephalic hood or collar (Pl. III, Figs. 18, 19), 1.50 mm. to 1.65 mm. wide and 1.05 mm. to 1.17 mm. long. The dorsal margin of the hood is unbroken but the ventral margin is indented by a wide shallow notch or hilus (Fig. 17). The whole hood has the general appearance of a cocked hat; its ventral face is slightly concave, with the lappets not prominent, giving the whole somewhat the shape of a kidney. A well defined muscular oral sucker lies in the ventral cupped face of the hood, but an acetabulum is not present (Figs. 17, 18, 22).

At the posterior end of the body, on the dorsal surface, in the median line is a funnel-shaped opening, which marks the termination of the excretory system. The male and female genital pores are separate and salient; they lie on the medial side of the left intestinal caecum (Figs. 17, 22) at the level of the posterior margin of the anterior fourth of the body. The large cirrus was extruded in several of the specimens examined (Fig. 17).

Digestive System.— The oral sucker, having a fairly well developed musculature, opens directly into the œsophagus. It measured 0.66 mm. wide by 0.60 mm. long. A pharynx is not present. The length of the œsophagus varies much; in some specimens it appears to be wanting, in others it may reach a length of 0.50 mm. The wide intestinal caeca occupy a lateral and dorsal position in the body and extend from the oral sucker in an undulating course to near the end of the body, where they end blindly. The caeca throughout their

course are folded or pleated, which gives rise to distinct but irregular pockets along their course.

Male genitals.— One of the most characteristic features of this trematode is the testes (Fig. 22), twelve in number, arranged in two groups of six each. They are small, irregular, lobed bodies situated in the posterior third of the worm lying on each side of the body immediately ventral to the terminal portions of the intestinal caeca. Taken together the testes have the shape of a horseshoe, with its open end directed cephalad and extending from the level of the ovary and vitelline glands caudad to the ends of the intestinal caeca. The testes may be separated from, or may overlap, one another. A small duct connects all the testes comprising each group and a larger duct, the vas efferens, passes mediad from the anterior testis of each group. The vas efferens from the left side passes transversely across the body and unites with the short vas efferens from the right side. The vasa efferentia uniting from a short vas deferens, which passes cephalad in the right mediolateral field and joins a long tubular convoluted seminal vesicle, which runs anteriorly, mediad to the right intestinal caecum, and enters the cirrus pouch (Fig. 22). The seminal vesicle is lined with a high columnar epithelium.

The cirrus pouch (Figs. 22, 20) is a very muscular elongated sac lying between the intestinal caeca at the level of the posterior margin of the anterior fourth of the body. It extends obliquely across the body from right-dorsal to left-ventral and enters the male genital pore. It is provided with an outer thick sheet of strong longitudinal muscle fibers and an inner (toward its lumen) thin sheet of circular muscle fibers. Parenchymal tissue fills the space between these muscle sheets. The seminal vesicle enters the base of the cirrus pouch, where it enlarges to form a short tubular pars prostatica, which is surrounded by the prostate cells. The pars prostatica enters a cone-shaped cavity, the ductus ejaculatorius, which is one-fourth of the length of the pouch and is lined with high columnar epithelial cells having the appearance of coarse cilia. The ductus ejaculatoris is followed by a narrow canal which forms the lumen of the cirrus (Fig. 20).

The cirrus is strongly developed and consists of two distinct regions, both of which are protrusile. The basal proximal portion is bulbous and in one specimen measured 0.33 mm. long by 0.25 mm. in diameter; the distal portion is more slender and tapering and in the same specimen measured 0.50 mm. long by 0.125 mm. in diameter. The distal portion can be retracted into the bulbous portion. The entire extruded cirrus may be 0.85 mm. long. The cirrus is covered with a

cuticula in which, on the distal portion, are lightly embedded minute spinelets. It is supplied with an outer sheet of circular muscle fibers and an inner thicker sheet of longitudinal muscle fibers. Its lumen is lined with cuticula. The external opening of the cirrus pouch is separate from that of the metraterm, or vagina, and lies mesad to it and to the left intestinal caecum.

Female genitals.— The ovary (Figs. 13, 22) is a little larger than a single testis and is irregular in outline with a lobed margin. It lies at the right of the median plane, posterior to the uterus and at the level of the most anterior testes. A short oviduct leaves the dorso-medial portion of the ovary and, proceeding obliquely dorsad and to the left, is joined by the Laurer's canal, whence it turns posteriad and mediad across the dorsal surface of the shell-gland (gland of Mehlis) and is joined in the central area of the shell-gland, by a duct from the yolk reservoir. The common duct now enters the shell-gland and enlarges, forming the oötype, which receives numerous small ducts from the shell-gland, after which it passes ventrad and posteriad through the shell-gland to its posterior margin, whence, after making several coils, it turns cephalad along the left side of the shell-gland and continues as the uterus. The uterus makes its way cephalad, in the median area, in wide compact transverse folds, which may extend laterally as far as the outer edge of the intestinal caeca and vitelline glands. The uterus terminates in a well defined metraterm, or vagina, which opens to the exterior through a separate female genital pore (Figs. 17, 20, 22) at the left of the male genital pore and ventral to the left intestinal caecum. The metraterm is an elongated slightly convoluted tubular organ, approximately as long as the cirrus pouch, and lies caudad, and almost parallel, to the pouch. Its wall is strikingly thick and muscular, being provided with a thick outer layer of longitudinal muscle fibers and a thick inner (toward the lumen) layer of circular fibers. Its lumen is lined with a thick layer of cuticula, which is raised into longitudinal ridges.

A compact, irregularly shaped, shell gland, or gland of Mehlis (Figs. 13, 22), as large as the ovary, lies in the median field at the left of, and more dorsal than, the ovary. A receptaculum seminis is not present. A short Laurer's canal leaves the oviduct near the ovary and proceeds dorsad and cephalad opening on the dorsal surface at the right of the median line and slightly anterior to the shell-gland.

The vitellarium (Fig. 22) is composed of two groups of vitelline glands lying in the lateral fields of the third fourth of the body, ventral to the intestinal caeca. Each group is made up of from seven to ten

compact coarsely granular glands, which are so arranged as to simulate an anterior prolongation of the free ends of the testicular horseshoe; they extend cephalad to approximately the same level on the two sides of the body. A small vitelline duct connects the successive glands of each group; a larger one leaves the posterior gland of either side and, passing caudad and mediad, unites with its mate to form a yolk reservoir (Fig. 13), which lies dorsal to the anterior portion of the shell gland. A small yolk duct leads from this reservoir and joins the oviduct in the central area of the shell gland.

Excretory System.— Two lateral canals, one on each side of the body, arise at the level of the œsophagus. They parallel the sides of the body and lie slightly external and ventral to the intestinal caeca. At the level of the anterior testes their course becomes obliquely caudomediad and they unite just posterior to the shell-gland to form the excretory bladder, which lies in the median plane at about the level of the more posterior testes and ventral to the intestinal caeca. The bladder extends backward in a straight course from the shell gland and terminates in the excretory funnel near the posterior end of the body. The funnel itself runs dorso-caudad and opens through an excretory pore on the dorsal surface in the median line 0.15 to 0.30 mm. from the posterior margin of the body. According to Looss (1902 : 593) this excretory funnel (Figs. 14–17, 22) is characteristic of the *Pronocephalidae;* it is lined by cuticula raised into 7 to 9 longitudinal ridges. Cilia were not observed in the funnel, the inner end of which is surrounded by numerous gland cells.

The uterus is packed with numberless eggs; those from different parts of the uterus were studied. In mass the eggs appear dark brown, but individual eggs are light brown or golden yellow. In shape (Fig. 21) they vary from short or long oval to ovoid, and every egg bears a tuft of filaments at each pole. The body of the egg in glycerine preparations varies from 0.0287 to 0.0387 mm. in length, and from 0.0162 to 0.0187 mm. in width. The shell is thick and has at the more pointed end a definite flattened operculum, but without an opercular rim. Six to ten coarse filaments, which may attain a length of 7 times that of the egg proper, occur at the opercular pole and there are at the opposite end 12 to 20 coarse very long filaments, 15 times as long as the egg proper, with an equal number of short finer filaments. The diameter of the coarser filaments is about one-half the thickness of the egg shell and they appear to be composed of the same material. The intertwining of these filaments causes a characteristic massing of the eggs, and makes it difficult to separate them.

2. Taxonomy.

The presence of the single sucker, the cephalic hood, and the peculiar funnel-shaped depression which is associated with the excretory pore undoubtedly place this trematode in the Family *Pronocephalidae* as characterized by Looss (1902, p. 611). It cannot, however, be placed in the genus *Charaxicephalus* of Looss on account of the difference in the number, arrangement and position of the testes and other, though minor, differences.

It has many of the characters given by Braun (1901, p. 48) for *Monostomum pandum*, which he describes as follows: "Mir liegt nur ein einziges, wohl erhaltenes Exemplar vor, das folgende Verhältnisse aufweist: es ist 11 mm. lang, kahnförmig gekrümmt, verhältnismässig platt, der Rücken gewölbt, die Bauchfläche konkav; weder der Hinterrand noch die Seitenränder sind wie bei *Mon. trigonocephalum* bauchwärts eingebogen: am Hinterrande keine Spur von irgend welchen Anhängen. Das Kopfende trägt ein nierenförmiges, dem Halskragen der Echinostomen ähnliches Schild (2 mm. breit), aus dem sich ein niedriger, an der Spitze die Mundöffnung tragender Kegel erhebt: offenbar entspricht dieses Schild dem Kopfwulst der bisher besprochenen Monostomen aus Seeschildkröten, der demnach auf der Ventralfläche nur schwach gebogen und nicht winklig ausgeschnitten ist wie bei *Mon. trigonocephalum* Rud. Die Breite des Körpers beträgt in der Höhe der Genitalpori 2.7, am Beginn der Dotterstöcke 3.5, und in der Höhe des Keimstockes 4 mm.; sie nimmt also ganz allmählich von vorn nach hinten zu.

Der Saugnapf ist 0.625 mm. lang und 0.729 mm. breit; vom Oesophagus kann ich etwas bestimmtes nicht angeben, da ich ihn nicht sehe, allem Anschein nach ist er kurz, denn die beiden Darmschenkel sind bei genügend starker Vergrösserung sowohl auf der Rücken- wie Bauchfläche dicht hinter dem Kopfschild bereits erkennbar: sie ziehen, die Endteile der Geschlechtsgänge zwischen sich fassend nach hinten und sind zwischen den Dotterstöcken und dem Uterus bis an die Hoden zu verfolgen; ihr weiterer Verlauf ist nicht mit Sicherheit zu erkennen, sie scheinen dorsal über den Hoden und der Mittellinie etwas mehr genähert bis an den Hinterrand der Hoden sich zu erstrecken. Soweit ich sie deutlich erkenne, sind sie nach aussen wie nach innen mit kurzen Blindsäckchen besetzt.

Vom Exkretionsapparat sind nur die beiden weiten Sammel-röhren aussen von den Dotterstöcken erkennbar.

Wie häufig bei *Monostomiden*, findet sich auch hier je eine Aus-

mündungsstelle für männliche und weibliche Organe; dieselben liegen dicht neben einander, hinter der Gabelstelle des Darms auf der linken Seite, die Uterusmündung seitlich von der Cirrusmündung. Ganz im Hinterende liegen symmetrisch die beiden grossen (bis 3 mm. langen) vielfach gelappten Hoden; sie berühren sich hinten mit ihren medianen Flächen, vorn weichen sie auseinander. Vom Leitungsweg bemerkt man rechts die gewundene Vesicula seminalis, die durch einen graden Kanal in den langgestreckten und dickwandigen Cirrusbeutel mündet; seine Lange beträgt über 2 mm.

In dem von den vorderen Enden der Hoden freigelassenen Raume liegt rechts der vierstrahlige Keimstock, neben und etwas hinter diesem in der Mittellinie die Schalendrüse. Hier beginnt der Uterus, auch fliessen an dieser Stelle die queren Dottergänge zusammen. Die Dotterstöcke liegen wie gewöhnlich seitlich im Korper und erstrecken sich vom Vorderende der Hoden bis vor die Körpermitte; sie bestehen aus zahlreichen, eine traubige Gruppierung aufweisenden Follikeln.

Die Uterusschlingen breiten sich, quere Richtung einhaltend, in dem Raum zwischen den Dotterstöcken und vor den Geschlechtsdrüsen aus; das neben dem Cirrusbeutel liegende Metraterm ist kurz vor seiner Ausmündung von einer kompakten Drüsenmasse umgeben. Die Eier scheinen Polfäden nicht zu besitzen; sie liegen allerdings so dicht im Uterus, dass sich Filamente den Blicken leicht entziehen könnten, andererseits würde aber, wenn Filamente vorhanden wären, kaum eine sehr dichte Lagerung der Eier möglich sein; Messungen an jungen, sicher der Anhänge entbehrenden Eieren aus dem Anfangsteil des Uterus ergaben 0.035 mm. Länge und 0.01 mm. Breite."

It is evident that the trematode which I have described differs from *M. pandum* not only in minor details but more especially in the larger number of testes.

Pratt (1914, p. 411) has described a monostome trematode, *Wilderia elliptica*, found in the Loggerhead Turtle from the Tortugas, which has many characters in common with both *M. pandum* and the form here described, but differs from both of them in the absence of a cephalic collar or hood. On the ground of the absence of a collar and the presence of several testes Pratt has created the new genus and new species *Wilderia elliptica*. The trematode described in this paper cannot be classed as *M. pandum*, on account of the several testes, nor as *Wilderia elliptica*, on account of the presence of a definite cephalic hood or collar.

If, as Pratt (1914, p. 416) suggests, Braun's description of the testes

in *M. pandum* is incorrect and "they are as a matter of fact made up of successive pairs of distinct organs," then the trematode which I have described may be identical with *Monostomum pandum*. Also, if Pratt is in error regarding "the slightest indication of the collar-like cephalic ridge at the forward end of the body" being absent in *Wilderia elliptica*, his species is probably identical with the trematode which I have described and with *Monostomum pandum*. Until these points are determined, it seems advisable to create a new genus and a new species for this trematode, which I accordingly designate as *Synechorchis megas*, making it the type species of a new genus, *Synechorchis*,[1] designed to include those monostome trematodes which have a continuous cephalic collar, and numerous testes placed laterally in the posterior part of the body.

The material, on which these descriptions are based, was collected and sent to me by Prof. E. L. Mark, Director, and Dr. W. J. Crozier, Resident Naturalist, of the Bermuda Biological Station. To both of them I wish to acknowledge my appreciation and indebtedness.

To Mr. Hiram O. Studley, one of my students, I desire to express my appreciation for his assistance in making a preliminary study and drawings of the second form described in this paper.

[1] Συνεχής, continuous line, and ὄρχις, testicle.

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EXPLANATION OF PLATES.

All drawings were made with the aid of a camera lucida except Figures 10, 11 and 12.

Abbreviations

act.	Acetabulum	*o'typ.*	Oötype
cae. in.	Intestinal caeca	*phx.*	Pharynx
can. exc.	Excretory canal	*po. exc.*	Excretory pore
can. L.	Laurer's canal	*po. gen.*	Genital pore
cir.	Cirrus	*po. gen.'*	Male genital pore
coll.	Collar	*po. gen.''*	Female genital pore
cstr. vt.	Yolk reservoir	*poc. v.*	Ventral cup
dt. vt.	Yolk duct	*rcp. sem.*	Recaptaculum seminis
fil. pol.	Polar filament	*sac. cir.*	Cirrus pouch
gl. cnch.	Shell gland	*suc. or.*	Oral sucker
gl. prost.	Prostate gland	*te.*	Testis
gl. vt.	Vitelline glands	*ut.*	Uterus
oa.	Ovary	*va. df.*	Vas deferens
oes.	Oesophagus	*vg.*	Vagina
o'dt.	Oviduct	*vs. exc.*	Excretory vesicle
op.	Operculum	*vsl. sem.*	Vesicula seminalis

PLATE I.

Pachypsolus brachus.

FIGURE 1. Ventral view. × 40. Scale line, at the margin, represents 1 mm.
FIGURE 2. Dorsal view of unmounted specimen. × 40. Scale line 1 mm.
FIGURE 3. Cirrus pouch, vagina, acetabulum, etc. Composite view obtained by superposing several successive para-sagittal sections. × 80.
FIGURE 4. Eggs with and without lid. × 110. Scale line 0.1 mm.
FIGURE 5. Dorsal view. × 40. Scale line 1 mm.
FIGURE 6. Reconstruction of female genitals, based on frontal and sagittal sections. × 60.

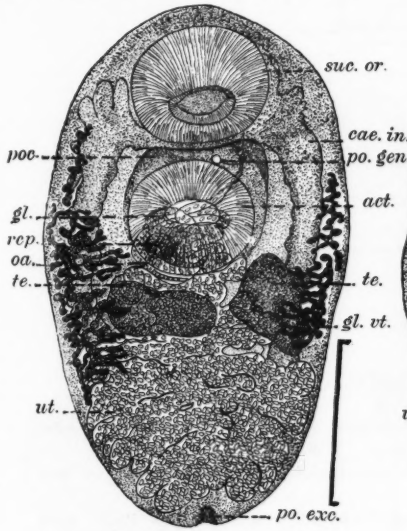

Fig. 1

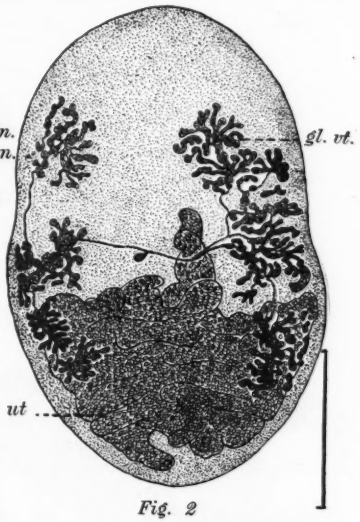

Fig. 2

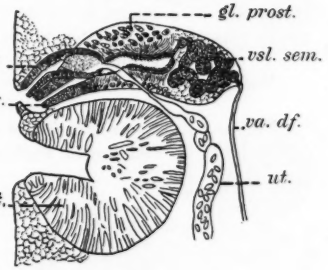

Fig. 3

Fig. 4

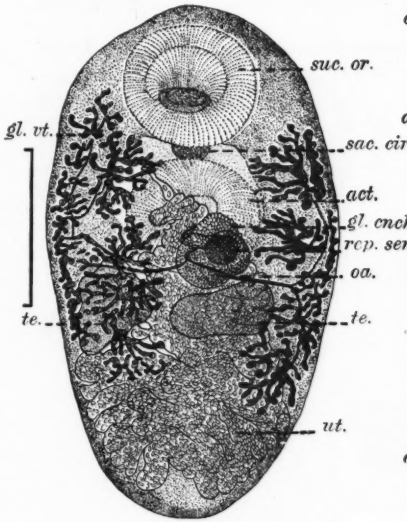

Fig. 5

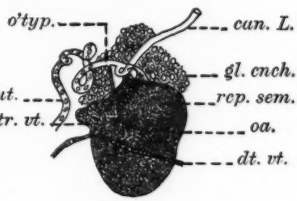

Fig. 6

PLATE II.

FIGURE 7. Reconstruction of excretory system of *Pachypsolus brachus* based on frontal sections. × 50.

FIGURE 8. Ventral view of unmounted specimen of *Pachypsolus brachus*. × 30.

FIGURE 9. Cirrus pouch etc. of *Pachypsolus tertius*, after Pratt 1914, Figure 2. × 64.

FIGURE 10. Cirrus Pouch etc. of *Pachypsolus ovalis*, after Linton 1910, Figure 7. × 60.

FIGURE 11. Cirrus pouch etc. of *Pachypsolus irroratus*, after Looss 1902, Figure 169. × 38.

FIGURE 12. Reconstruction of digestive tract of *P. brachus* based on frontal and sagittal sections. × 50.

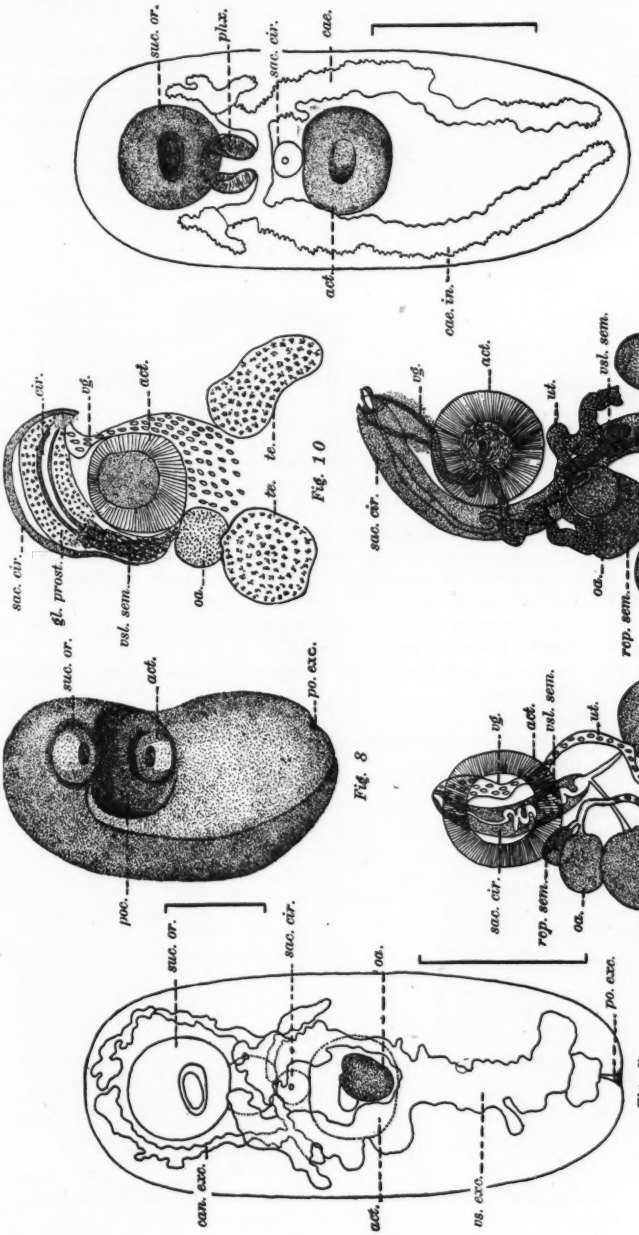
suc. or.
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Fig. 18
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Fig. 10
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Fig. 11
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Fig. 9
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ns. exc.
Fig. 7
ZATS. del.

PLATE III.

Synechorchis megas.

FIGURE 13. Reconstruction of female genitals, dorsal aspect, based on frontal and sagittal sections. × 220. Scale line, below the figure, represents 0.1 mm.
FIGURE 14. Sagittal section of excretory funnel. × 250.
FIGURE 15. Cross section of excretory funnel near surface level. × 250.
FIGURE 16. Cross section of excretory funnel at deeper level. × 250.
FIGURE 17. Ventral view of unmounted specimen. × 23.
FIGURE 18. Ventral view of cephalic region of unmounted specimen. × 68.
FIGURE 19. Sagittal section of cephalic hood. × 75.
FIGURE 20. Details of male and female copulatory organs. × 90. Scale line 0.5 mm.
FIGURE 21. Egg. × 500.
FIGURE 22. Ventral view of mounted compressed specimen. × 33. Scale line 1 mm.

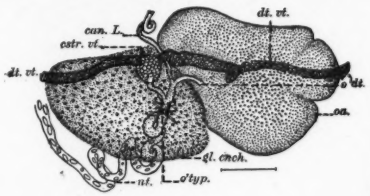

Fig. 1 3

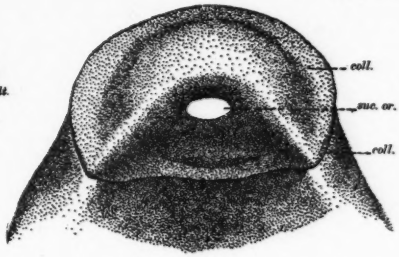

Fig. 1 8

Fig. 1 4

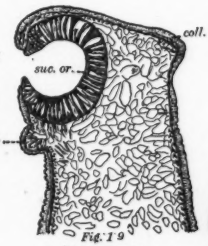

Fig. 1 9

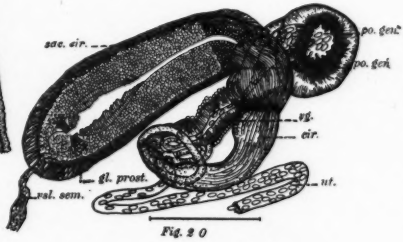

Fig. 2 0

Fig. 1 5

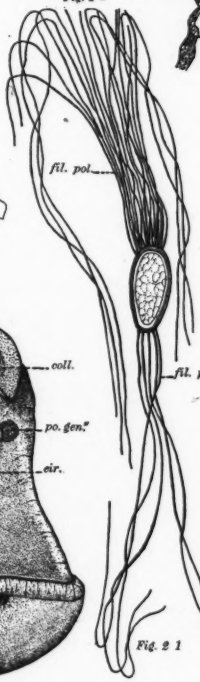

Fig. 2 1

Fig. 1 6

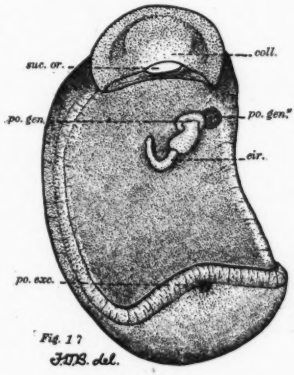

Fig. 1 7

HMB. del.

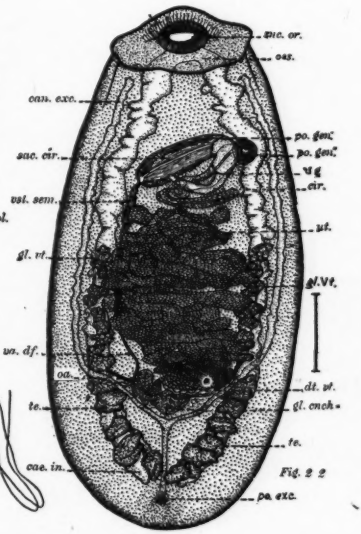

Fig. 2 2